Nov. 24, 1936. A. A. THOMAS 2,062,259

REMOTE CONTROL DEVICE FOR RADIO RECEIVERS

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Fig. 1

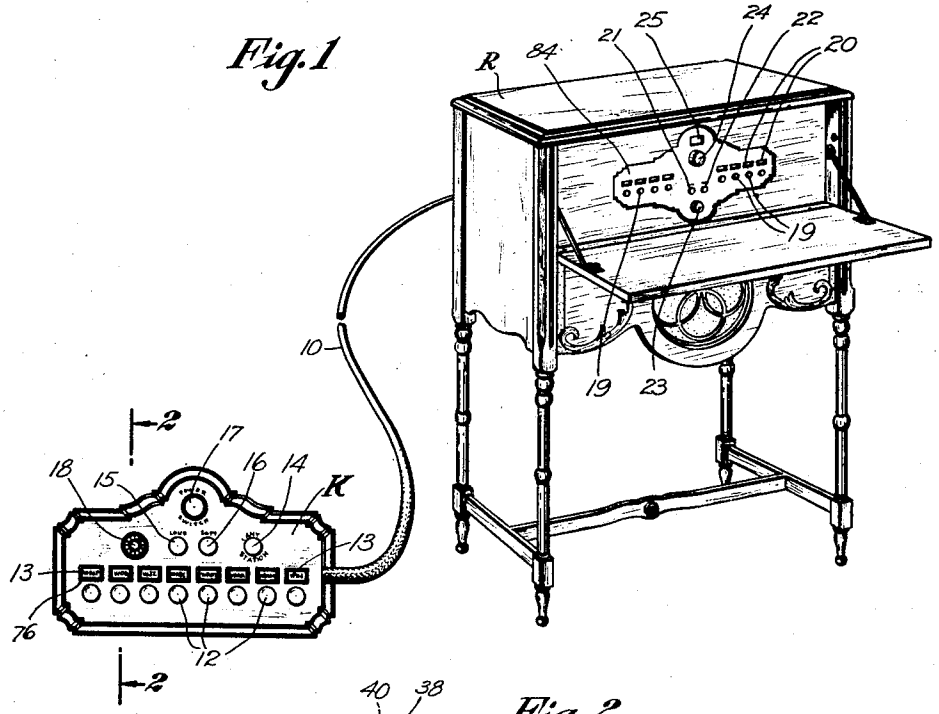
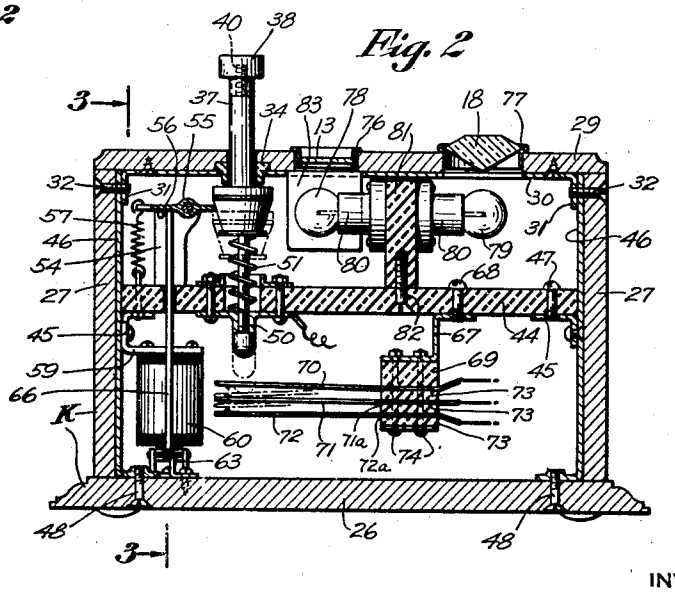


Fig. 2



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Fig. 3

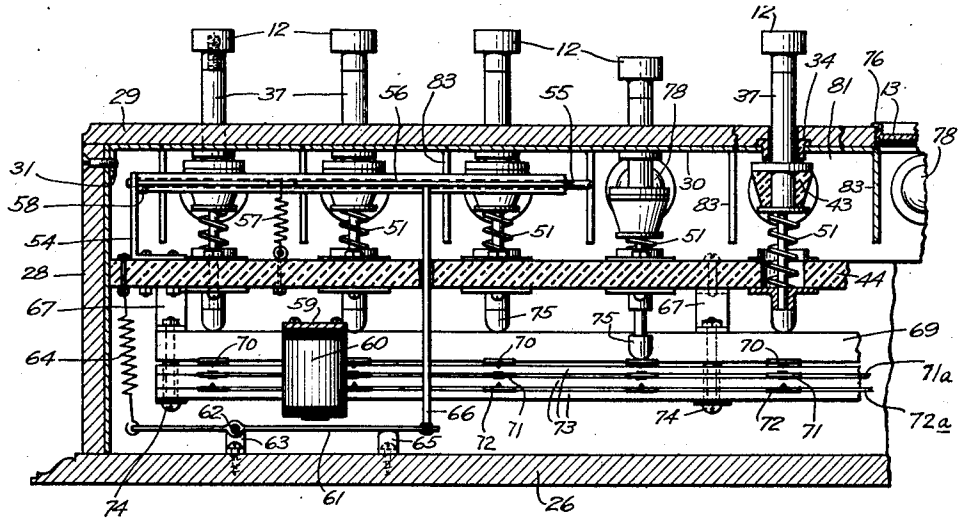


Fig. 4

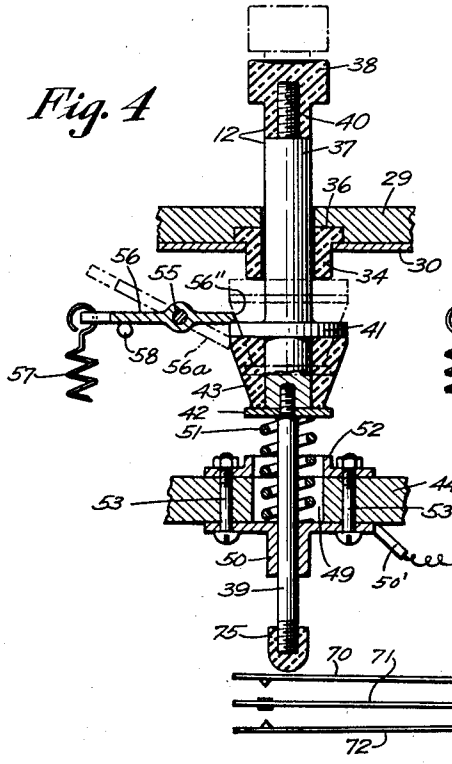
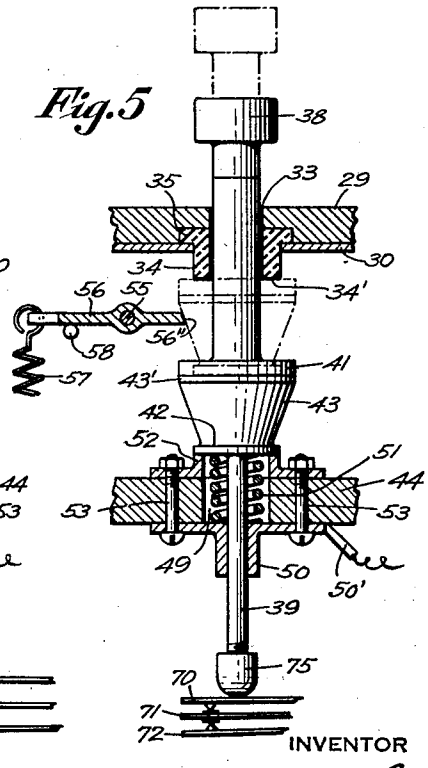


Fig. 5



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Fig. 6

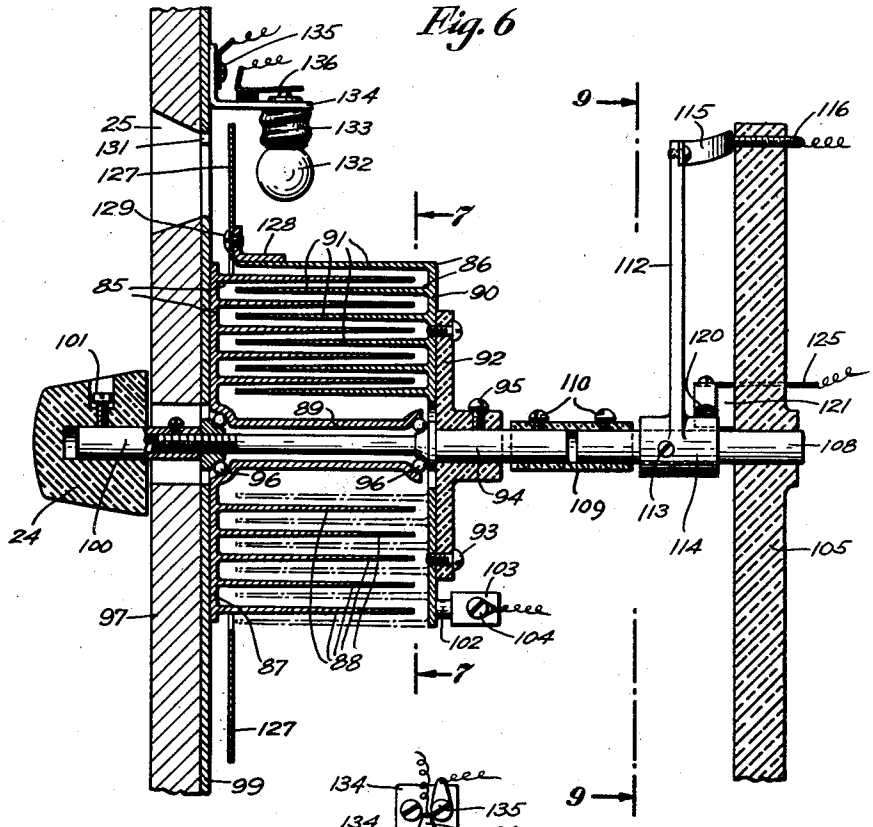
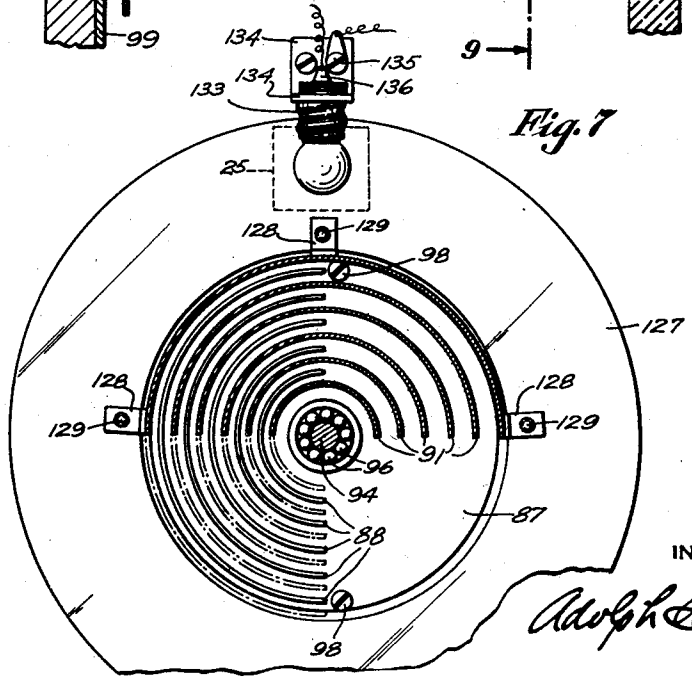


Fig. 7



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Fig. 8

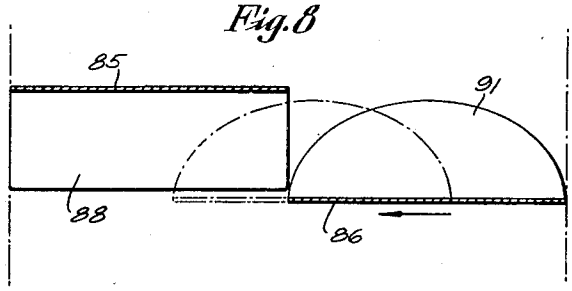
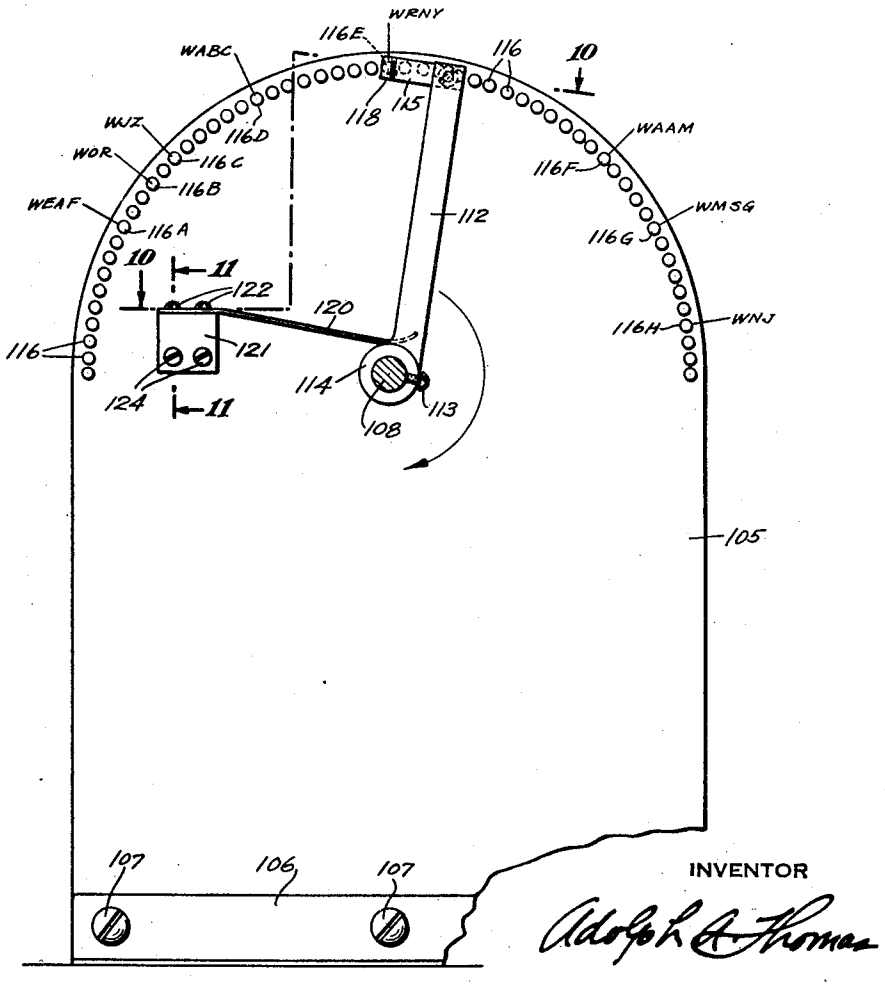


Fig. 9



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Fig. 10

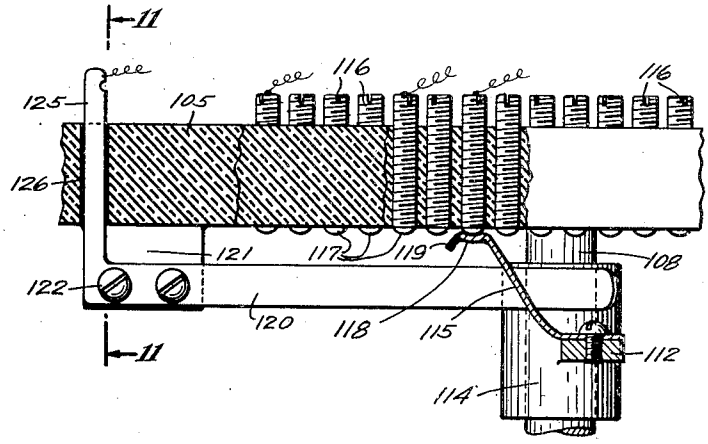


Fig. 12

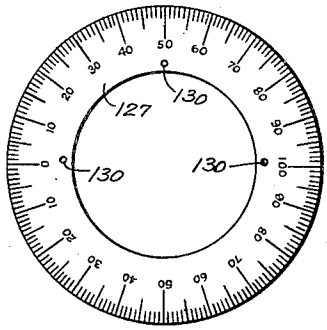


Fig. 11

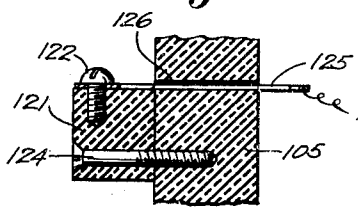
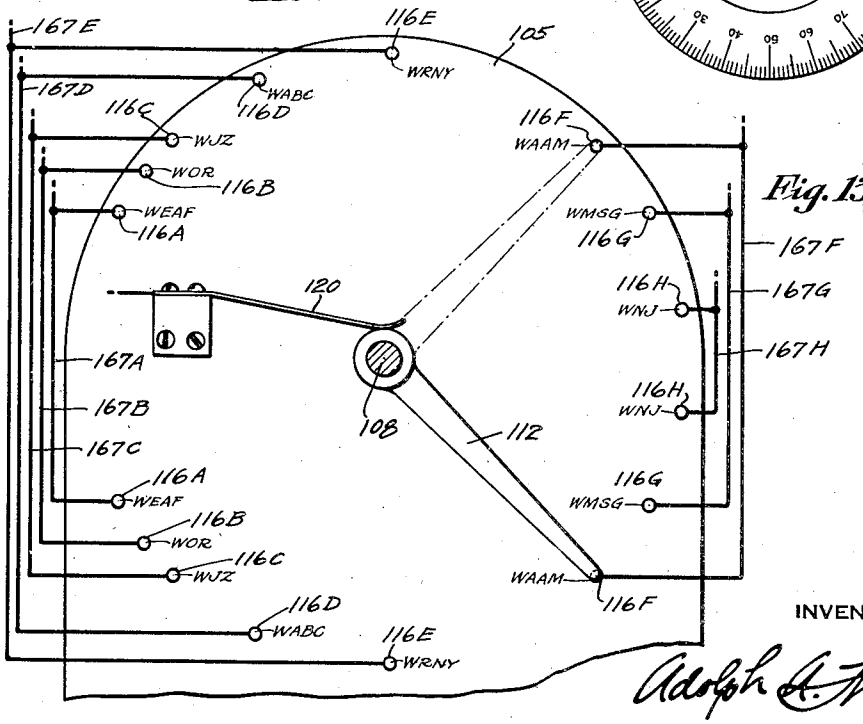


Fig. 13



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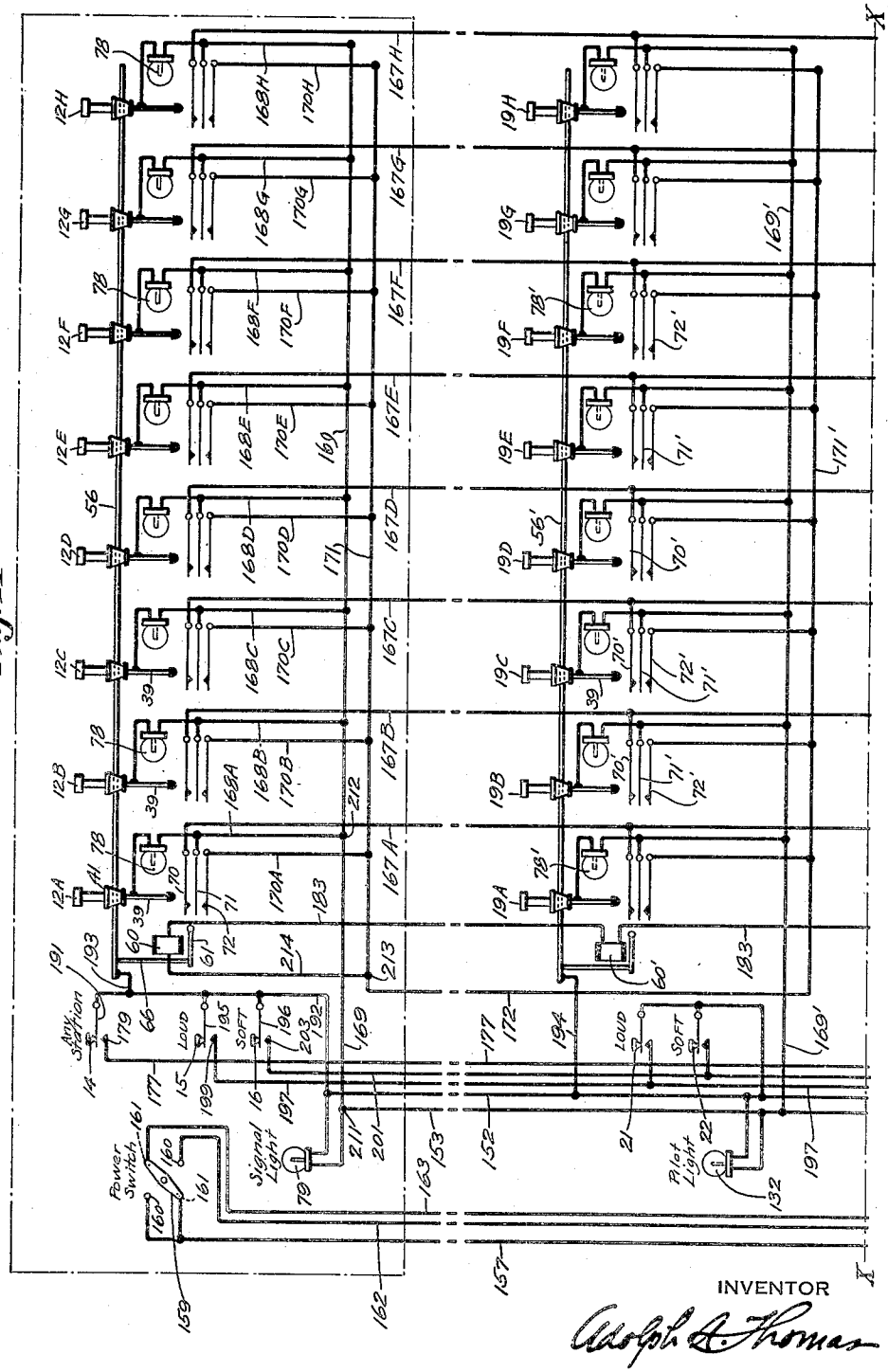
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Fig. 14



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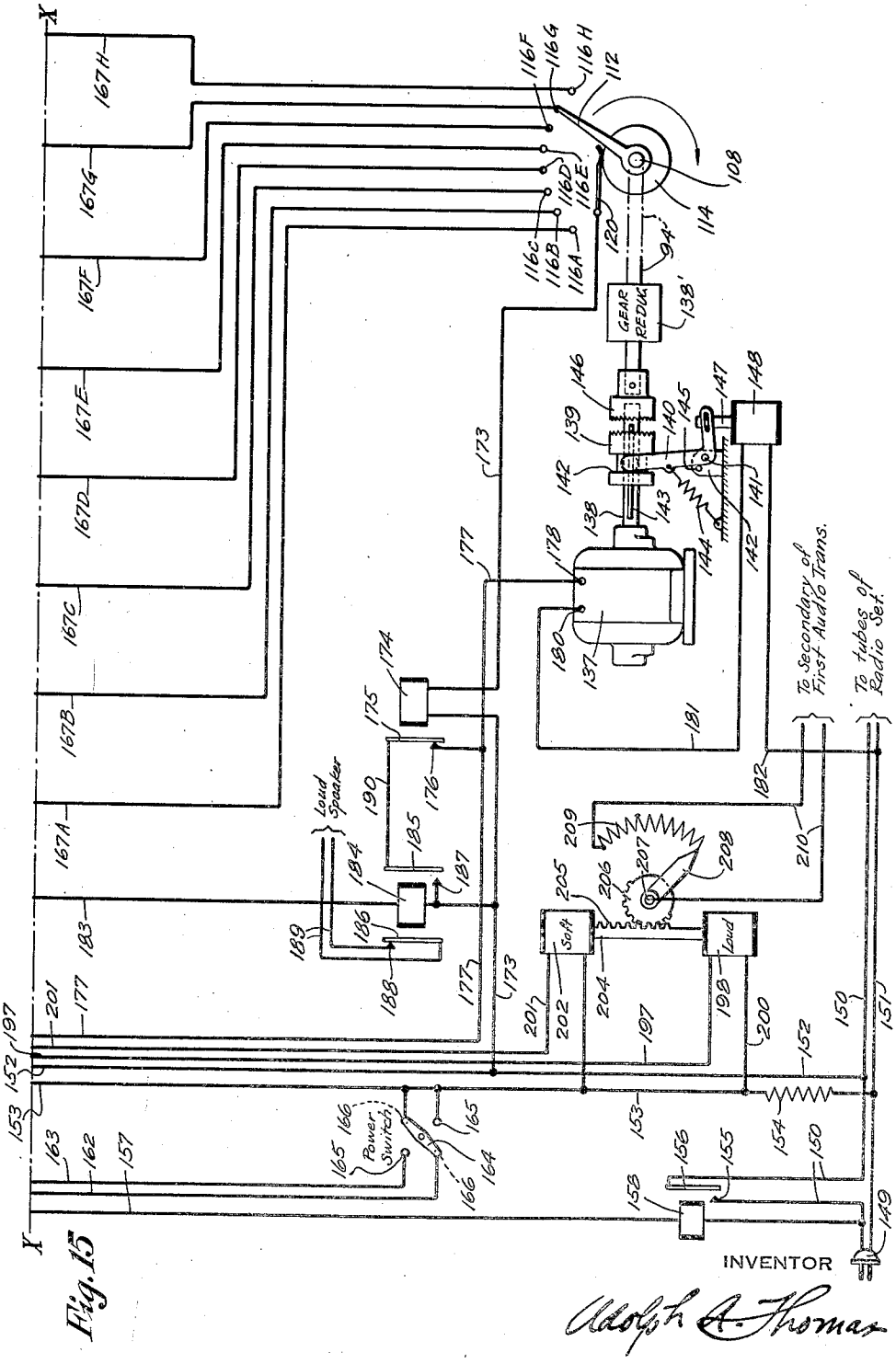


Fig. 15

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Patented Nov. 24, 1936 2,062,259

UNITED STATES PATENT OFFICE

2,062,259

REMOTE CONTROL DEVICE FOR RADIO RECEIVERS

Adolph A. Thomas, New York, N. Y., assignor to Radio Corporation of America, New York, N. Y., a corporation of Delaware

Application February 26, 1930, Serial No. 431,377

4 Claims. (Cl. 250—20)

This invention relates to the art of tuning radio receivers from a distance, and its object is to provide remote control apparatus of simple construction and operation.

Briefly stated, my invention comprises a remote control box having a set of keys or buttons which represent certain selected stations. When a key is pushed in, an electric motor in the radio cabinet actuates the tuning shaft, which operates a switch arm arranged to move over a set of contacts. The circuit connections between the control box and the tuning mechanism in the radio cabinet are such that the movable switch arm automatically opens the motor circuit when the selected station is in tune. The actuated key is thereupon released, but it returns only part way to normal position and closes a signal circuit which lights a lamp adjacent the key. This lamp remains lighted until the key is fully restored to normal position, so that the operator can always identify the station tuned in last. The cable that operatively connects the remote control box with the radio cabinet contains only wires of low voltage, so that no danger of electric shock or destructive arcing is possible. These electrical connections are so simple that only one wire for each key is required in the cable.

In addition to the automatic tuning keys, I preferably provide the remote control box with a dialing key to bring in any station within range of the receiver. As long as the dialing key is held down, the motor circuit is closed and the tuning shaft turns at sufficiently low speed to enable the operator to tell what kind of program is coming across as each broadcasting station is tuned in. When the operator gets what he wants, he simply lets go of the key and the station remains in tune. The loudspeaker circuit is always in operative condition when the dialing key is used, but the automatic tuning keys cause silent operation of the condenser shaft until the selected station is in tune. In other words, when the motor circuit is closed by one of the automatic tuning keys, the loudspeaker circuit is opened, and when the motor circuit is interrupted to stop the condenser shaft in tuning position, the loudspeaker circuit is automatically closed. This silent tuning feature is, however, not necessary to the operation of the system and may be omitted.

Another feature of my remote control box comprises novel means for regulating the volume of reproduction. Heretofore it has been the common practice to control the loudspeaker volume by turning a knob one way or the other, but I use a pair of push buttons, one for increasing the volume and the other for decreasing it. These two volume buttons control a rheostat arm in the receiver for regulating the loudspeaker output in any practical way. I also provide the control box with a switch for turning the electric power on and off, irrespective of whether the main switch on the radio cabinet was left open or closed. A signal light on the control box informs the operator whether the power is on or off. The receiver may be tuned by hand in the usual way, but I prefer to equip the same with a duplicate set of automatic tuning keys for preselected stations. This makes it possible to control the electric tuning mechanism either from the front panel of the cabinet or from the remote control box by no greater exertion than pushing a key or button, which even a small child can operate.

At the present time, the universal method of tuning radio receivers is by adjusting condenser elements through an arc of 180 degrees. That is to say, the tuning shaft must be reversed after each half revolution, which means at each end of the indicator dial. When the tuning shaft is driven by an electric motor, it has heretofore been necessary to provide reversing connections for the shaft, either by electrically reversing the rotation of the motor shaft or interposing a reversible drive between the two shafts. I do away with this complication by using a condenser structure in which the rotors always turn in the same direction. My novel condenser structure has the further advantage that the plates of each part can be cast as a unit, thereby reducing the cost of manufacture and the labor of assembly. The indicator scale may be mounted directly on one of the condenser rotors.

The various novel features and practical advantages of my tuning system will be understood from a description of the accompanying drawings which illustrate a preferred embodiment of my invention. In these drawings,

Fig. 1 illustrates a radio cabinet equipped with my remote control box;

Fig. 2 represents an enlarged transverse section through the control box on line 2—2 of Fig. 1;

Fig. 3 is a section partly on line 3—3 of Fig. 2, except that the entire length of the box is not shown for lack of space;

Fig. 4 shows how one of the automatic tuning keys is held locked against full return movement, the dotted lines indicating the key in normal position;

Fig. 5 shows the same key in fully depressed position to close the associated switches;

Fig. 6 is a cross-section through one of the tuning condenser assemblies and associated parts in the radio cabinet;

Fig. 7 represents a sectional view on line 7—7 of Fig. 6;

Fig. 8 is a diagrammatic outline of a condenser unit to indicate the interleaving of the plates;

Fig. 9 shows a face view of the switch mechanism controlled by the tuning shaft, this view being taken on line 9—9 of Fig. 6;

Fig. 10 is an exaggerated plan view sectioned approximately on the irregular line 10—10 of Fig. 9 to show certain structural details in the mounting and arrangement of switch contacts;

Fig. 11 is a section on line 11—11 of Fig. 10;

Fig. 12 shows an indicator ring having two oppositely arranged scales of 180 degrees each;

Fig. 13 is similar to Fig. 9, except that the station-selecting contacts are arranged in two semi-circular paths, this modification being used with the double indicator of Fig. 12; and

Figs. 14–15 together show diagrammatically the circuit connections between the remote control box and the radio cabinet.

Referring to Fig. 1, there is a radio receiver R of suitable construction and a remote control box K, which is operatively connected with the receiver through an electric cable 10. In the present embodiment of the invention, I have assumed that eight selected stations can be automatically tuned in from the control box K and so the latter is provided with eight tuning keys or push buttons 12. Opposite each key is a window 13, which may bear suitable notations to identify the particular station represented by the key. The control box K is further provided with a dialing key 14 for tuning in any station within the operating limits of receiver R. Two keys or push buttons 15 and 16 are used for controlling the loudspeaker volume, one key increasing the volume and the other cutting it down. A rotary knob 17 turns the electric power for the receiver on and off. When the power is on, a light shines through a brightly colored lens 18. To bring in a station represented by one of the keys 12, the operator need only push in the proper key as far as it will go and hold it in that position until he hears the broadcast of the selected station through the loudspeaker. When the key is released, the adjacent window 13 automatically lights up as a visual identification of the station in tune. I may provide for silent tuning by holding the loudspeaker cut out until the actuated key is released. It takes only a second or two for the electric motor in the radio cabinet to turn the tuning shaft to preselected position. If a person wants to get a station not represented by the keys 12 or likes to explore the entire broadcasting range, he pushes in key 14 and listens for the broadcast of each station as it comes in tune. When key 14 is released, the tuning shaft of the receiver instantaneously stops.

The front panel of radio receiver R may be provided with a set of automatic tuning keys 19, which are a duplicate of keys 12 in the remote control box K and represent the same stations. Each key 19 has a window 20 which automatically lights up when the selected station is in tune. The buttons 21 and 22 are for the purpose of controlling the loudspeaker volume, the same as buttons 15 and 16 of the remote control box. A knob 23 on the receiver operates a switch for turning the electric power on and off. The switches controlled by knobs 17 and 23 are preferably so connected that either switch is capable of turning the electric power for the receiver on and off without regard to the condition of the other switch. The dialing key 14 of control box K is replaced in receiver R by a knob 24 for manual tuning in the usual way, although a dialing key may be provided in the receiver in lieu of the hand-tuning knob. A window 25 in the front panel of the receiver shows a suitable station indicator. I might explain at this point that when I refer to the parts 12, 14 and 19 as keys or buttons, both in the description and claims, I use those terms in the broadest possible sense to include any practical form of hand-operable switch member, of which a key or push button is probably the most popular type.

The mechanism inside the remote control box K is shown in Figs. 2–5, which I shall now describe in detail. The outer walls of the box, which may be of wood, bakelite or other suitable insulating material, comprise a base 26, sides 27, ends 28 and a top plate or cover 29. The underside of cover 29 carries a sheet lining 30 which is bent to provide flanges 31 for receiving screws 32 or other fastening members. The automatic tuning keys 12 pass through openings 33 in cover 29 and insulating bushings 34 of rubber or fiber may be used to furnish increased bearing surface for the keys. A simple way to hold the bushings 34 in place is to provide them with an annular flange or shoulder 35 which fits in a recess 36 in top plate 29 and is engaged by the sheet lining 30. This is clearly shown in Figs. 4 and 5. Each key 12 comprises a stem 37 having a lower extension 39 and provided with a cap 38, which is preferably mounted for easy removal, as by engaging a screw 40 mounted in the upper end of stem 37. The caps 38 may be molded of bakelite, celluloid, fiber, and the like, and each cap has marked thereon the call letters or other identifying marks of the particular station represented by that key. These caps may be colored to harmonize with the design and coloring of the box, and each cap may have a different color from the others to assist a person in recognizing the various stations represented by the keys. Thus, for example, the key cap for station WEAF may be blue, the cap for station WJZ may be red, and so on for the other stations.

The stems 37 of keys 12 have each a pair of disks or rings 41 and 42, between which is mounted an insulating sleeve or bushing 43 of frusto-conical shape. If the key stems 37 are of metal, the rings 41 may be formed integral with the stems, but if the latter are molded of insulating material like hard rubber, "Bakelite", fiber, etc., the metal rings 41 are attached separately. As will appear later, the rings 41 should be of good conducting metal which is not too soft, like certain kinds of hard brass, bronze and other alloys and metals used for electrical conductors. The insulating sleeves or bushings 43 may be molded in place between the rings 41 and 42, but it is probably easier to mold them separately and attach them to the key stems in any practical way. For example, the extension 39 may be screwed into the lower end of stem 37 to lock the ring 42 and bushing 43 firmly in position against the contact disk 41.

The remote control box K has a transverse partition 44 supported on brackets 45 carried by sheet metal linings 46 which cover the sides 27. If the partition 44 fits snugly within the box, no separate fastening means is necessary, but screws 47 may be used to connect the partition to brackets 45.

The linings 46 may be of stiff sheet metal like aluminum and secured to the base 26 by screws 48 or otherwise. The partition 44 is preferably a panel of wood, bakelite, hard rubber, fiber, or other strong insulating composition. The key extensions 39 pass through holes 49 in partition 44 and guide pieces 50 are preferably attached to the underside of partition 44 in axial alignment with the bushings 34, whereby the keys are held steady in their reciprocable movements. An expanding coil spring 51 surrounds each key extension 39 between the ring or washer 42 and guide piece 50, as shown in Figs. 4 and 5. The normal tendency of spring 51 is to hold the key projected, this movement being limited by the ring 41 engaging the underside 34' of bushing 34. The inward movement of the keys against the action of spring 51 is stopped when the ring 42 strikes a collar 52 attached to the upper side of partition 44, as illustrated in Fig. 5. The same bolts 53 may be used for securing the parts 50 and 52 to the opposite sides of partition 44. The key extension 39 and guide pieces 50 are of good conducting metal and electrically connected with the contact rings 41, for a purpose to be later explained. A tongue or strip 50' attached to each guide piece provides an easy way to connect a conductor.

The transverse partition or panel 44 carries a pair of brackets 54 for supporting a rod 55 on which a plate 56 is pivoted. A contracting coil spring 57 normally holds the pivoted plate 56 in horizontal position against one or more stops 58 projecting from brackets 54. When the plate 56 is in normal horizontal position, as shown in Figs. 4 and 5, the bevelled edge 56'' is in contact with (or nearly touches) the conical sleeve 43 at a point below the larger base 43' of the sleeve. In other words, the edge 56'' of plate 56 is normally nearer to the axis of the key stem 37 than is the circumferential edge of ring 41. Consequently, when the key is pushed in, the plate 56 is tilted to permit full inward movement of the key. As soon as the ring 41 of the actuated key passes the edge 56'' of plate 56, the tensioned spring 57 pulls the plate back to normal position, thereby locking the key against full return movement. This will be clear by looking at Fig. 4, where the tilted position of plate 56 is indicated by the dotted outline 56a. Since the locking plate 56 is common to all keys 12, the actuation of a second key rocks the plate to position 56a and causes it to release the previously locked key. The locking plate 56 consists of good conducting metal, or at least that part of it which engages the rings 41 of the keys is a good conductor, because the additional function of plate 56 is to close a lamp circuit when it engages the metal ring 41 of an actuated key. I shall go into this more fully later on.

Referring to Figs. 2 and 3, a bracket 59 secured to one of the sheet linings 46 below the partition 44 carries an electromagnet 60. An armature bar 61 is pivoted at 62 between a pair of brackets or lugs 63 which project upwardly from the bottom plate 26 of the box. A contracting coil spring 64 normally holds the armature bar 61 against a stop 65. A vertical rod 66 is connected to the free end of armature 61 and projects through an opening in partition 44 into contact with the underside of the pivoted locking plate 56. It is clear from Figs. 2 and 3 that when the electromagnet 60 is energized, the free end of armature 61 is raised and the rod 66 rocks the plate 56 to position 56a (see Fig. 4) and thereby releases a previously locked key for return to normal position. As will be explained later, the electromagnet 60 is automatically energized when any tuning key 10 of the radio receiver is actuated.

Still referring to Figs. 2 and 3, one or more brackets 67 are secured to the underside of partition 44 by screws or bolts 68, and these brackets carry an insulating bar 69. Below each tuning key 12 are three spring arms 70, 71 and 72, which are connected to bar 69 by three insulating strips 73. Bolts 74 hold the bar 69 and strips 73 connected to bracket 67, and at the same time clamp the spring arms 70, 71 and 72 rigidly in position. The spring arms 70 are separately insulated members, but the arms 71 are electrically connected to a common conductor and they can therefore be stamped as integral lateral extensions of a metal strip 71a. Similarly, the spring arms 72 may be integral lateral extensions of a conducting strip 72a. Any other practical means may be employed for supporting the sets of spring arms 70, 71 and 72 in operative relation to the tuning keys 12. The ends of the metal key extensions 39 are covered with an insulating pad or button 75, which may simply be a piece of hard rubber screwed to the inner end of each key. The spring arms 70, 71 and 72 constitute switch members which normally remain open by their inherent set or tension. When a key 12 is pushed in as far as it will go, the switch arm 70 is moved into contact with arm 71 and the latter is forced into contact with arm 72. The circuits controlled by these switch arms will be fully described in connection with Figs. 14 and 15.

The windows 13 in the top plate of control box K are enclosed by suitable frames 76, which are shown rectangular but which may obviously be circular, elliptical, or of any other desired outline. The frames 76 can be stamped from sheet metal and are preferably removable individually from cover plate 29 for easy replacement of a window when necessary. The same remarks apply to frame 77 which carries the lens or jewel 18. Below each window 13 is a small electric lamp 78 and a similar lamp 79 is arranged below the jewel 18. The pilot lamps 78 and 79 are mounted in sockets 80 attached to an insulating strip 81 which is secured to partition 44 by screws 82 or otherwise. If desired, the lamp-supporting strip 81 may be secured to the underside of cover plate 29, so as to be removable therewith. To confine the light of each lamp 78 to the associated window 13, I provide shields 83 which may be formed integral with the sheet lining 30. When the cover 29 is removed, easy access is had to lamps 78 and 79, as well as to the other mechanism above partition 44. For access to the parts below partition 44, it is only necessary to take out the bottom screws 48 and remove the base 26. The mechanism in remote control box K is duplicated in the radio receiver, so that the foregoing description is also applicable to the key-controlled mechanism behind the escutcheon plate 84 on the front panel of the radio cabinet. The only difference between the two mechanisms is the absence of the dialing key 14 in the radio receiver, although such a key may be used in place of the hand knob 24. The lens or jewel 18 in control box K is not duplicated in the escutcheon plate 84 of the radio cabinet, because the pilot light in the cabinet shines through the opening 25 when the power is on, as I shall presently explain more fully.

Figs. 6, 7, and 8 show my novel condenser unit which permits rotation of the tuning shaft continuously in the same direction by an electric

motor. This condenser unit comprises a stator 85 and a rotor 86. The stator 85 consists of a base disk 87 provided with a set of semi-cylindrical plates 88 arranged in concentric spaced relation. A tubular bearing 89 projects centrally from the base member 87. The rotor 86 consists of a base disk 90 provided with semi-cylindrical plates 91 arranged in concentric relation to overlap the stator plates 88 without touching them. The clearance between the two sets of plates is made as small as mechanical conditions permit. The condenser parts 85 and 86 may each consist of a single casting of aluminum, duralumin, brass, or other suitable conducting material. To increase the rigidity of plates 88 and 91, they may taper slightly toward their free ends as shown in Fig. 6. The number of plates on each condenser part may be varied in accordance with the size and maximum capacity of the condenser, and as many condenser units may be employed as the receiver system requires. The shape of the condenser plates 88 and 91 depends upon the rate of capacity variation obtained per unit angle of rotation. In Fig. 8 the stator plates 88 are square and the rotor plates 91 have a curved edge to give the requisite rate of capacity variation. At the present time most condensers are designed to give a straight line frequency effect.

The condenser rotor 86 is secured to an insulating plate 92 by screws 93, and this plate is fixed on a rotary shaft 94 by set-screw 95 or otherwise. Roller bearings 96 support the tuning shaft 94 in the hub or sleeve 89 of stator 85, which is secured to the front panel 97 of the radio cabinet by screws 98 or otherwise. A suitable sheet lining 99 of metal or hard insulating material may be attached to the inner face of front panel 97. The outer end of shaft 94 carries a sleeve 100 to which the hand knob 24 is removably attached by a set-screw 101 or otherwise. In the particular construction shown in Fig. 6, the stator 85 is grounded to the metal framework in the cabinet, but it may be insulated like the rotor 86. A convenient way of connecting the rotor 86 in circuit is by supporting a spring-pressed brush or other contact member 102 in firm pressure engagement with the base disk 90 of the rotor. In Fig. 6 the contact brush 102 is mounted in a fixed support 103, which has a binding post 104. For convenience I shall refer to shaft 94 as the tuning shaft, but that does not mean that the tuning elements must be mounted thereon. On the contrary, the tuning elements may be mounted on separate shafts operatively connected to shaft 94. I therefore want it understood that when I speak of a tuning shaft in the description, and particularly in the claims, I mean any shaft operable to adjust the tuning elements in the receiver.

The radio cabinet contains an upright panel 105 which is rigidly attached to a base piece 106 by screws or bolts 107, as shown in Fig. 9. The panel 105 is preferably of bakelite, fiber, hard rubber or non-warping wood. A shaft 108 is connected to the tuning shaft 94 by an insulating sleeve 109 and screws 110, or in any other practical way. The two shafts 94 and 108 are thus in effect a single shaft consisting of two insulated sections. The inner end of shaft 108 is supported in panel 105, and a contact arm 112 is fixed on the shaft at the proper angle. A set-screw 113 held in the hub or sleeve 114 affords an easy way to adjust the contact arm 112 to correct angular relation to the rotor plates 91. The free end of arm 112 carries a spring finger 115 arranged to engage a set of contacts 116 mounted in panel 105. These contacts may be screws adapted to be inserted into the panel from the rear by an ordinary screwdriver, and the front ends of these screws are preferably rounded as indicated at 117 in Fig. 10. The contact finger 115 terminates in a concave extension 118 adapted to fit against the rounded ends 117 of contacts 116. In this way the spring finger 115 is sure to make a good electrical connection with each contact 116 during the rotation of arm 112. If the hand-knob 24 is used for turning the tuning shaft 94 in either direction, the spring finger 115 is bent back at 119, so that the lateral extension 118 can easily slide over the rounded contact ends 117 in either direction of rotation of arm 112. To compensate for any wear in the rounded ends 117, the screw contacts 116 are individually adjustable in an axial direction.

In Fig. 9 the contacts 116 extend over half the circumference and are shown so close together as to represent practically all the stations that are licensed to broadcast. If it is desired to use the remote control box K for only a certain number of stations, it will be necessary to have only the same number of contacts 116. For example, we may suppose that the eight tuning buttons 12 in control box K and the corresponding eight buttons 19 on the front panel of the radio receiver are intended to tune in the stations identified in Fig. 9. In that case we need only eight contacts 116 arranged in correct angular relation, as can be easily determined by experiment. A spring finger 120 is mounted at one end on a lateral lug or block 121 by screws 122, and the free end of this finger presses constantly against the sleeve or bushing 114 of contact arm 112. The block 121 is secured to panel 105 by screws 124. The contact finger 120 has a lateral extension 125 which passes through a slit 126 in the panel. The rear end of extension 125 is easily accessible for attaching an electric conductor, as shown in Figs. 10 and 11. Any other practical means may be used to connect the rotary contact arm 112 in circuit.

Referring to Figs. 6 and 7, behind the window 25 in front panel 97 of the radio cabinet is a station indicator 127 in the form of a flat ring of transparent or translucent material attached to the condenser rotor 86. For this purpose the outer semi-cylindrical plate 91 of the rotor carries several right-angled lugs 128 for receiving screws 129 which pass through holes 130 in the indicator ring 127. As shown in Fig. 12, the ring 127 bears two complete tuning scales extending each a half circumference in opposite directions. For convenience each scale is marked with 100 divisions in accordance with the usual practice. A good material to use in the manufacture of the indicator ring 127 is sheet celluloid from which the rings can be stamped out and marked in a single operation. The celluloid may be suitably colored and have just the right degree of transparency to permit easy reading of the scale. An arrow or pointer 131 cut in sheet lining 99 (Fig. 6) may serve as a stationary index for the scales on ring 127. The reason why a double scale is used on ring 127 is because the condenser plates 88 and 91 are adjustable to the same position twice for each revolution of shaft 94. A pilot lamp 132 is mounted behind the indicator ring 127 in line with window 25 to light the visible portion of the scale. The metal socket 133 of lamp 132 is carried by a right-angled metal bracket 134 attached to the inner side of front panel 97 by a screw 135, which may also be used as a binding post for a conductor. An in-

sulated metal strip 136 engages the central contact of lamp 132. This arrangement makes it very easy to connect the lamp in circuit.

Figs. 14 and 15 illustrate diagrammatically the various circuit connections by which the radio receiver is tuned electrically either from the control box K or from the front panel of the cabinet. These two figures go together and are supposed to be a single figure separated along the imaginary line X—X. Since the mechanism associated with the automatic tuning keys 19 in the radio cabinet is the same as that within the control box K, I have indicated corresponding parts of the two mechanisms by like reference characters, except that for distinction I have used a prime mark with the reference characters of certain parts controlled by the keys 19. For example, the switches 70', 71' and 72' associated with each key in the radio receiver corresponding to the switches 70, 71 and 72 in the remote control box K; the individual signal lamps 78' in the radio receiver correspond to the signal lamps 78 in the remote control box; and so on for other corresponding parts in the control box and the radio cabinet. For distinction, the automatic tuning keys 12 and 19 are individually identified by the suffix letters A—H, which may be regarded as representing the eight stations that have been selected for automatic tuning. For the same reason, the eight contacts 116 in Fig. 15 are differentiated by the suffix letters A—H. The stations represented by the contacts 116A—116H are identified in Figs. 9 and 13 by their call letters. It goes without saying that the equal spacing of contacts 116A—116H in Fig. 15 is merely for convenience. An approximately accurate spacing of those contacts for the selected stations is indicated in Figs. 9 and 13.

Referring to Fig. 15, there is an electric motor 137 whose shaft 138 carries a slidable clutch ring 139 arranged to be operated by a bellcrank 140 pivoted at 141 on a suitable support 142 in the radio cabinet. The free end of lever 140 may be in the form of a yoke adapted to engage in an annular groove 142 of clutch ring 139 according to the usual practice. A key or spline 143 on the armature shaft 138 locks the clutch ring 139 to the shaft for rotary movement therewith and at the same time permits axial movement of the clutch ring by bellcrank 140. A contracting coil spring 144 normally pulls the bellcrank 140 to the left against a fixed stop 145. The tuning shaft 94 carries a clutch member 146 adapted to interlock with the slidable clutch ring 139 when the latter is moved to operative position. The lower arm of bellcrank 140 is connected to a magnetic plunger 147 arranged to reciprocate in an electromagnetic coil 148. When this coil is energized, the plunger 147 is pulled down and the bellcrank 140 is rocked clockwise to shift the clutch ring 139 into coupling engagement with clutch member 146. The tuning shaft 94 is thereby connected to the motor shaft 138 through a suitable speed-reducing device 138'. When coil 148 is de-energized, the contracting coil spring 144 instantly pulls the clutch ring 139 away from clutch member 146, so that the tuning shaft 94 is disconnected from the motor. Another practical advantage of normally disconnecting the tuning shaft from the motor is that the radio receiver can be tuned by hand in the usual way without turning the motor shaft 138.

A plug 149 adapted to be inserted into a house-lighting socket is connected to a pair of mains 150 and 151 which lead to the radio receiver for supplying the necessary electric power, as will be understood without further explanation. Two branch conductors 152 and 153 lead from the mains 150 and 151 and pass through the cable 10 to the remote control box K. A resistance 154 is included in conductor 153 to reduce the working voltage as required. In actual practice this reduced voltage need not exceed ten volts and less will probably be sufficient. The service main 150 has an on-off switch of suitable construction which is diagrammatically represented in Fig. 15 by a fixed contact 155 and a movable magnetic arm 156 adapted to remain normally in open position. A conductor 157 connected to service main 150 contains a relay coil 158 arranged to attract the armature 156 and close the main power switch. The rotary knob 17 on the remote control box K (see Fig. 1) actuates a pivoted switch arm 159 which is shown diagrammatically in the upper left corner of Fig. 14. Two pairs of stationary contacts 160 and 161 are arranged to be engaged by switch arm 159. Suitable stop means in box K limit the rotary movements of knob 17 in such a way that when the knob is turned one way, the arm 159 connects the diametrically opposite contacts 160, and when the knob is turned the other way as far as it will go, the arm 159 connects the two contacts 161. The two left contacts 160 and 161 are connected in parallel to conductor 157, and the two right contacts 160 and 161 are connected to conductors 162 and 163 respectively.

The rotary hand-knob 23 at the front panel of the radio cabinet (see Fig. 1) is connected to a pivoted switch arm 164, which is shown diagrammatically in Fig. 15 at the left. Two pairs of contacts 165 and 166 are arranged to be engaged by the rotary switch arm 164 when the latter is moved to one position or the other. That is to say, when the knob 23 is turned in one direction, the switch arm 164 connects the opposite contacts 165, and when the knob is turned the other way, the arm 164 connects the two contacts 166. The two left contacts 165 and 166 are connected to conductors 163 and 162 respectively, and the two right contacts 165 and 166 are connected in parallel to conductor 153. The relay coil 158 can be energized to close the main power switch 156 by turning either the knob 17 on the remote control box K or the knob 23 on the radio cabinet, and it makes no difference in which position either knob was left. For instance, in Figs. 14–15 the switch arms 159 and 164 are in such position that the circuit of relay coil 158 is open. To energize this coil from the remote control box, the operator turns knob 17 until the switch arm 159 connects the two contacts 160, whereupon the circuit is closed through coil 158 as follows: starting from service main 151, through resistance 154, conductor 153, across the switch contacts 166 which are connected by the conducting arm 164, through wire 162 in cable 10 across the contacts 160 which are now connected by the switch arm 159, through conductor 157 and coil 158 back to the return main 150. When a person wants to turn on the power from the radio cabinet (assuming that the arm 159 connects contacts 161), he turns the knob 23 to connect the two contacts 165 by switch arm 164, whereupon the circuit of relay coil 158 is closed, as will be understood without tracing the circuit in detail.

Of course, a person operating either the knob 17 of the remote control box or the knob 23 of the radio cabinet can not know in what position the switch arms 159 and 164 were left, but it is only

necessary to turn the knob one way or the other until the pilot lamps 78 and 132 are lighted. These lamps, as will be seen in Fig. 14, are connected to conductors 152 and 153, and they light when the switch 156 is closed. The electric power for the receiver may not only be turned on independently by the switch arms 159 and 164, but it may also be turned off by actuating either arm. For example, if a person turns the power on by means of knob 23 on the radio cabinet, the power can be turned off by simply moving the knob 17 on the remote control box until the lamp 78 is extinguished. Even though a person may not be using the remote control box, the lighting of lamp 78 informs him that somebody has turned on the power in the radio cabinet. Likewise, a person seeing a light shine through the window 25 of the radio cabinet is informed that somebody has turned the power on from the remote control box K.

The station-selecting contacts 116A—116H in Fig. 15 are connected to the switch arms 70 of the automatic tuning keys 12A—12H in the remote control box by conductors 167A—167H respectively. The switch contacts 71 are connected to conductors 168A—168H, respectively. These conductors are connected in parallel to a common conductor 169, which is connected to conductor 153. The switch arms 72 in the remote control box are connected to conductors 170A—170H respectively, and these conductors are in turn connected in parallel to a common conductor 171, which is connected to a wire 172 in cable 10. The switch arms 72' in the radio cabinet are similarly connected to a conductor 171' which in turn is connected to the cable wire 172. The switch arms 71' in the radio cabinet are connected in parallel to a common conductor 169' which corresponds to conductor 169 in the remote control box and is likewise connected to conductor 153. The switch arms 70' in the radio cabinet are connected to the wires 167A—167H in cable 10, the same as the switch arms 70 in the remote control box. The individual station lamps 78 in the control box are connected at one side to the metal key stems 39 and at the other side to the common conductor 169 through the parallel branches 168A—168H. The individual lamps 78' in the radio receiver are connected in a similar way. It will be understood that the parallel branches 168A—168H and the common conductor 169 represent diagrammatically the conducting strip 71*a* in the remote control box, while the other strip 72*a* is indicated in Fig. 14 by the parallel branches 170A—170H and their common conductor 171.

The spring contact 120, which engages the hub 114 of the rotary arm 112 in the radio cabinet, is connected by a wire 173 to conductor 152. A relay coil 174 connected in series in wire 173 controls a movable switch armature 175 which normally engages a fixed contact 176 connected to a wire 177. This wire leads from the motor terminal 178 and passes through cable 10 into the remote control box K where it terminates in a contact 179. The other motor terminal 180 is connected to one side of clutch coil 148 by a wire 181, and the other side of this coil is connected by a wire 182 to the service main 151. It is seen from this that the clutch coil 148 and electric motor 137 are connected in series, thereby reducing the voltage in cable wire 177 to a harmless amount. A wire 183 leads from one side of the key-releasing coil 69 in the remote control box to conductor 173 in the radio cabinet, and the other side of this coil is connected to the common conductor 171 in the control box. The wire 183 includes not only the key-releasing coil 69' in the radio cabinet, but also a relay coil 184 which controls two armatures 185 and 186. The armature 185 is a magnetic spring arm normally out of engagement with a stationary contact 187, while the other armature 186 is a spring arm normally engaging the associated contact 188. The parts 186 and 188 constitute a normally closed switch in the loudspeaker circuit 189. The relay armatures 175 and 185 are connected by a wire 190. In the actual device the relay coils 174 and 184 with their associated armatures will be mounted on a common support to form a compact structure that can be inserted as a unit into the radio cabinet.

The dialing key or button 14 in the remote control box is connected to (or otherwise operates) a switch arm 191 which may be in the form of a spring blade like the switch members 70—72. The normal set or tension of spring arm 191 is such that it remains out of engagement with the associated contact 179. A wire 192 connects the switch arm 191 with conductor 152 to which the pivoted key-locking plates 56 and 56' are also connected, as indicated by wires 193 and 194. The volume-control buttons 15 and 16 on the remote control box operate spring arms 195 and 196 connected to conductor 192. A wire 197 extends from one side of a solenoid coil 198 in the radio cabinet to a switch contact 199 in the remote control box, and the other side of that coil is connected by a wire 200 to conductor 153. Therefore, when the "loud" key 15 is pushed in, the switch 195—199 is closed and coil 198 is energized. A wire 201 leads from one side of a solenoid coil 202 in the radio cabinet to a switch contact 203 in the remote control box. When the "soft" key 16 is actuated, the switch arm 196 engages contact 203 and the coil 202 is energized.

Referring to Fig. 15, the two coils 198 and 202 control a reciprocable magnetic plunger 204 which comprises (or otherwise operates) a rack bar 205 arranged in mesh with a gear wheel 206 mounted on a shaft 207. A rheostat arm 208 is fixed on shaft 207 or otherwise moves with gear wheel 206 and controls a resistance element 209. The rheostat members 208 and 209 are connected to conductors 210 which are suitably connected to the radio receiver in such a way that a variation of resistance 209 controls the volume of loudspeaker reproduction. One way of obtaining this result is to connect the wires 210 to the secondary coil of the first audio transformer, but there are other ways of controlling the loudspeaker volume. When the "loud" coil 198 is energized, the rheostat arm 208 is rotated to cut out more of the resistance 209, so that the loudspeaker volume is increased. When the circuit of the "soft" coil 202 is closed, the arm 208 is rotated the other way to cut in more resistance and thereby decrease the volume. The solenoid plunger 204 preferably operates with a retarded movement, so that the arm 208 swings slowly over resistance 209 for a gradual variation of the loudspeaker volume. An ordinary dashpot arrangement may be used to bring out this slow movement. It is understood that the plunger 204 and arm 208 remain in actuated position.

In describing the operation of the remote control box K, we may assume that a person wishes to tune in station WEAF. After turning on the

power switch by means of knob 17, he pushes key 12A in as far as it will go. This operation energizes the relay coil 184 through the following circuits: starting with service main 151, through conductor 153 to point 211, conductor 169 to point 212, conductor 168A, through closed switch contacts 71—72, conductors 170A and 171 to point 213, connection 214 through coil 60, cable wire 183, through coil 60' and relay coil 184, conductors 173 and 152 to return main 150. The energizing of coil 60 in the remote control box performs no useful function at this time and may be disregarded, but the energizing of the corresponding coil 60' in the radio cabinet releases any previously actuated key for return to normal position. The energizing of relay coil 184 closes the switch contacts 185—187 so that the circuit through clutch coil 148 and electric motor 137 is closed as follows: from service main 151, conductor 182, coil 148, conductor 181, through the windings of motor 137, conductor 177, across the closed switches 176—175 and 185—187, and through conductors 173 and 152 to the return main 150. The energized coil 148 immediately couples the tuning shaft 94 to the motor shaft 138 through clutch members 139—146, as previously explained, and the switch arm 112 rotates over the station-selecting contacts 116A—116H. The energized relay coil 184 also opens the loudspeaker switch 186—188 for silent tuning. This switch may, however, be omitted without affecting the operation of the tuning system.

When the arm 112 engages contact 116A (which represents station WEAF), the relay coil 174 is energized through these connections: from service main 151, conductor 153 to point 211, conductor 169 to point 212, conductor 168A, through closed switch contacts 71—70, conductor 167A, contact 116A, switch arm 112, contact finger 120, conductor 173, coil 174, and through conductor 152 to the return main 150. The energizing of coil 174 opens the switch member 175 and breaks the circuit of motor 137 and clutch coil 148. Consequently, the condenser shaft 94 stops instantly in tuning position for the selected station WEAF. The disconnection of shaft 94 from motor shaft 138 prevents the latter from communicating its momentum to the tuning shaft when the motor circuit is interrupted. This insures the stopping of shaft 94 in preselected tuning position and also permits hand tuning of the radio receiver in the customary way. When the switch 186—188 is used, the loudspeaker is not head until the actuated key is released, but the operator is sure of his station by holding the key down for a few seconds.

When the operator releases the depressed key 12A, the associated coil spring 51 (see Fig. 4) throws the key up until the contact shoulder 41 strikes the metal locking plate 56. This closes the circuit through lamp 78 opposite key 12A through conductor 168A (which is connected to service main 151 as above explained), key extension 39, contact shoulder 41, metal plate 56, conductors 193 and 192, and through wire 152 to the return main 150. The lamp 78 remains lighted until the key is returned to normal position, or until all the electric power is cut off. The return of key 12A to the position shown in Fig. 4 automatically opens the associated switch members 70, 71 and 72, so that the circuits through relay coils 174 and 184 are opened. Consequently, there is no waste of current in the tuning mechanism after the selected station has been brought in. When coil 184 is de-energized, the loudspeaker switch 186—188 is automatically closed.

When any other tuning key 12B to 12H is actuated to select a certain station, the operations above described for key 12A are repeated, except that the motor circuit is interrupted when the switch arm 112 engages the particular contact 116 that is associated with the actuated key. For example, when key 12D is pushed in, the circuit of motor 137 is opened when arm 112 engages contact 116D, and so on for the other automatic tuning buttons. The same operations take place when the tuning keys 19A—19H on the radio cabinet are operated. When the double arrangement of contacts 116A—116H shown in Fig. 13 is substituted for the single arrangement of those contacts in Fig. 15, no change is necessary except connecting the corresponding contacts of each set in parallel to the same conductor. For example, the two contacts 116A are connected to conductor 167A, the two contacts 116B are connected to conductor 167B, and so on for the other contacts. It is thus clear that in Fig. 13 the arm 112 engages a selected contact twice in each revolution, but the motor circuit will be opened when the arm 112 encounters the first one of the selected pair of contacts.

When the dialing key 14 on the remote control box K is pushed in to tune in on a suitable program without regard to the station it comes from, the motor circuit is closed as follows: service main 151, conductor 182, clutch coil 148, electric motor 137, cable wire 177, across the closed switch contacts 179—191, and through conductors 192 and 152 to the return main 150. The tuning shaft 94 is therefore rotated as long as key 14 is held in, and this operation is independent of switch arm 112 and contacts 116. When the operator gets a program that he likes, he simply lets go of key 14 and the tuning shaft stops instantly, because the motor circuit is interrupted.

Although I have shown and described certain specific constructions, I want it understood that my invention is not limited to the details set forth. It is to be expected that changes and modifications will occur to those skilled in the art in constructing my invention, without departing from the scope of the appended claims. It is not necessary that all the various features of my invention shall be embodied in the same apparatus, for it is evident that some features may be used without others.

I claim as my invention:

1. The combination of a radio receiver having tuning mechanism, a set of keys for controlling said mechanism, a remote control box having a like set of keys for controlling said mechanism independently of said first set of keys, the corresponding keys of each set representing a selected station, a locking device for each set of keys to prevent an actuated key from returning to normal position, and means whereby the operation of a key in one set actuates the locking device of the other set to release a previously actuated key.

2. In tuning apparatus for radio receivers, the combination of a tuning shaft, a switch arm operated by said shaft, a series of contacts arranged to be engaged by said arm, each contact representing a selected station, an electric motor for actuating said shaft, a loudspeaker circuit, a set of keys representing the same stations as said contacts, a switch operated by each key to close the motor circuit and open the loudspeaker circuit, a second switch operated by each key and connected in series with one of said contacts, and means

whereby the closing of said two series switches opens the motor circuit, the release of the actuated key automatically closing the loudspeaker circuit.

3. In a radio signal receiving system, a radio receiver having at least one tuning element, a motor for operating said tuning element, means at said motor including a plurality of conductors for selectively controlling the operation of said motor, selectively operable circuit-controlling means for completing a circuit for said motor including one of said conductors, a remote control station, conductors connecting said remote control station and said selectively operable circuit-controlling means, and mechanism including a plurality of interlocking keys at said remote control station for selectively extending said conductors terminating at said remote control station to complete a circuit for directively operating said circuit-controlling means, said keys being interacting so that the actuation of one key releases a previously actuated key.

4. In a radio signal receiving system, a radio receiver having at least one tuning element, a motor for operating said tuning element, means at said motor including a plurality of conductors for selectively controlling the operation of said motor, a progressively movable switch for completing a circuit for said motor including one of said conductors, a remote control station, conductors connecting said remote control station and said progressively movable switch, and mechanism including a plurality of interlocking keys at said remote control station for selectively extending said conductors terminating at said remote control station to complete a circuit for directively operating said progressively movable switch, said keys being interacting so that the actuation of one key releases a previously actuated key.

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